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OPERATING EXPERIENCE WEEKLY SUMMARY

Office of Nuclear and Facility Safety

July 3 - July 9, 1998

Summary 98-27

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EVENTS

1. PRESSURIZED AIR LINES REMOVED WITHOUT A LOCKOUT/TAGOUT

On June 22, 1998, at the Rocky Flats Environmental Technology Plutonium Processing and Handling Facility, deactivation and decommissioning workers violated lockout/tagout procedures when they loosened air-operated valve fittings on pressurized plant air lines. The workers were deactivating a glovebox before removing it and found some of the airlines pressurized when they loosened the fittings. The evolution supervisor knew that procedures required lockout/tagouts to be installed on the plant airlines. They were not installed, so he directed the workers to stop work and reported the incident. Failure to follow procedures and continuing to open fittings after finding some lines pressurized could have resulted in serious employee injuries. (ORPS Report RFO--KHLL-771OPS-1998-0028)

Investigators determined that the workers removed airlines in the area the previous day. They determined that the deactivation team lead had instructed workers to continue piping removal, but did not specify that a lockout/tagout needed to be installed on some lines before removing them. They also determined that when workers began work on the airlines they believed they were not pressurized because they had removed similar, unpressurized lines the previous day. However, the workers continued to open fittings even after they discovered that some lines were pressurized. Investigators also determined that the workers closed a valve that they believed turned off the system air when they realized that some lines were energized and then continued to work. Investigators determined that when the evolution supervisor became aware that workers were opening fittings on pressurized lines he stopped work because they were not authorized to work on energized systems and lockout/tagouts were not installed. Investigators also determined that workers met informally every day to discuss planned activities and any other information that could affect the job (such as building status or any problems that might be encountered) and were not required to attend daily, formal pre-evolution briefs.

The facility manager held a fact-finding meeting on this event. Meeting attendees learned that the lockout/tagout procedure requires facility personnel to lockout/tagout systems when (1) they contain a gas or vapor over 30 psig, or (2) they contain a liquid with a pressure over 90 psig or 120 degrees Fahrenheit. Attendees learned that the airlines were pressurized to approximately 90 pounds and should have been locked out and tagged out as required by the procedure. Attendees also learned that the workers believed they could open the fittings because they knew that the system was never activated (no contaminated or hazardous materials were introduced into the system). The facility manager concluded that the workers had a false sense of security regarding the associated hazards and that they were not properly prepared for the job. Meeting attendees also learned that (1) the job foreman was not present, thereby limiting work supervision; (2) workers were permitted by the work package to perform work in any order, and installing electrical and air lockout/tagouts was not listed as a prerequisite in the work package; (3) workers were not following ladder safety requirements; and (4) workers did not stop work when they encountered pressurized systems.

The facility manager directed the following corrective actions.

- All personnel involved will attend detailed daily pre-evolution briefs.
- All personnel involved will attend mid-day meetings to confirm work is proceeding as expected.
- Deactivation and decommissioning workers and supervisors will walk down the job daily before performing work.
- An evolution supervisor will develop and implement a system to uniquely identify lines designated for removal.
- Facility personnel will evaluate and revise the work package to ensure that lockout/tagouts are installed on the energized portions of the system before work is performed.

The facility manager will continue to review this event and will develop additional corrective actions as necessary.

NFS has reported on similar lockout/tagout violations in several Weekly Summaries. Following are some examples.

- Weekly Summary 97-45 reviewed five lockout/tagout events. One of these events involved maintenance mechanics at the Idaho National Engineering and Environmental Laboratory who installed a lockout/tagout on an instrument air line, then cut an adjacent, but incorrect, air line. (ORPS Report ID--LITC-SMC-1997-0007)

- Weekly Summary 97-32 reported that mechanics at the Los Alamos National Laboratory caused a positive ventilation condition in a wing of the Chemistry and Metallurgy Research facility while performing preventive maintenance on a compressed air system dryer. Investigators determined that the work package was not adequate and a lockout/tagout was not used on the air system that operated between 80 psig and 100 psig. (ORPS Report ALO-LA-LANL-CMR-1997-0009)

- Weekly Summary 96-21 reported that a subcontractor at the Savannah River F-Tank Farm removed a section of process air piping near a waste tank in violation of facility procedures. Neither the subcontractor technical representative nor the operations shift manager recognized the removal as requiring a documented lockout/tagout. (ORPS Report SR--WSRC-FTANK-1996-0008)

These events illustrate the need for facility managers to ensure that all personnel are made aware of the need for stringent work controls. This event might have been prevented if clear communication (in the form of work package instructions, pre-job briefs, or the supervisor's oral instructions) of work activities had taken place. Decommissioning procedures or work packages should identify all isolation boundaries and lockout/tagout requirements. They should also provide instructions for equipment removal and restoration, as well as precautions regarding the potential hazards. Plan-of-the-day meetings or pre-job briefings should be performed so that work organization responsibilities are clearly defined and the expectations of the task are understood.

- DOE O 4330.4B, *Maintenance Management Program*, section 8.3.1, provides guidelines on work control systems and procedures. The Order states that work control procedures help personnel understand the necessary requirements and controls. Section 3.4 identifies the elements of a maintenance management program that ensure planning, control, and documentation of maintenance.

- DOE O 5480.19, *Conduct of Operations Requirements for DOE Facilities*, states that DOE policy is to operate DOE facilities in a manner to assure an acceptable level of safety and to ensure procedures are in place to control conduct of operations. Chapter VIII, "Control of Equipment and System Status," provides an overall perspective on control of equipment and system status. Specific applications of system control are addressed in chapter IX, "Lockout/Tagout," and chapter X, "Independent Verification."

- DOE-STD-1030-96, *Guide to Good Practices for Lockouts and Tagouts*, states that a lockout/tagout must isolate all sources of energy or hazardous materials that may cause injury or equipment damage. A copy of the standard is available on the Department of Energy Technical Standards Home Page at URL http://www.doe.gov/html/techstds/standard/standard.html.

KEYWORDS: glovebox, pressurized, air, lockout and tagout, decommissioning

FUNCTIONAL AREAS: Decontamination and Decommissioning, Work Planning, Procedures

2. ELECTRICIAN INJURED BY ELECTRICAL ARC FAULT AND FLASH

On June 12, 1998, at the Hanford Site Waste Encapsulation and Storage Facility, an electrician received burns to his left arm and hand when an electrical arc and flash occurred while he was working on a modification to a motor control center. The work package required the electrician to remove a door-operating mechanism from a spare circuit breaker. When he reinserted the screws holding the spare circuit breaker to its mounting plate, one of the screws contacted the line-side wiring behind the breaker and penetrated the wire insulation. The resulting short created metal ion vapor in the bucket area, resulting in the phase-to-phase fault and flash at an adjacent 480-volt circuit breaker that burned the electrician. (ORPS Report RL--PHMC-WESF-1998-0006)

The facility support team coordinator discovered the injured electrician while investigating alarms and the cause of a backup diesel generator start-up. The injured electrician was walking out of the room where the motor control center panels were located. The coordinator called 911, and facility personnel administered first-aid until emergency medical personnel arrived and transported the electrician to a local hospital. Facility personnel determined that there was no release of radioactive material and restored normal power to affected systems.

Investigators determined that the electrician was wearing safety glasses, electrically insulated safety shoes, and standard short-sleeved coveralls. He was not wearing gloves or any other kind of hand protection. They also determined that the electrician was working alone when he was injured. Investigators determined that the line-side wire bundles were trained, routed, and tie-wrapped at the factory, and the faulted wire bundle was routed directly behind one of the four circuit breaker mounting holes. Investigators also learned that a 1995 fault and distribution system study included a recommendation that electricians install ground fault protection to bring the system into compliance with recent editions of the National Electrical Code. They determined that this recommendation was not implemented because of other plant priorities. Investigators believe that the lack of ground fault protection was a significant contributor to the severity of the accident. If ground fault protection had been installed, the ground fault would have caused the motor control center feeder circuit breaker to open, clearing the fault. This would most likely have occurred well before the fault expanded into a three-phase, line-to-line fault involving the adjacent circuit breaker. The damage caused by the arcing ground fault would have been minimized because the duration of the fault would have been much shorter.

Investigators also determined that all metal-to-metal contacts between the circuit breaker bucket and the motor control center chassis showed evidence of arcing, indicating less than adequate contact, increasing impedance in the fault return path, and lengthening breaker response time. They also determined that, at the time of the accident, the electrician was performing “No Release Required” work (skill of the craft) in preparation for completing specific steps in the work package. This work is not guided by formal, written direction. Operating contractor managers told investigators that removing parts from operating plant equipment is considered changing plant configuration and should not have been performed as “No Release Required” work.

Investigators determined that the root cause of the accident was less than adequate wire training (routing) by the motor control center manufacturer. They identified several factors that contributed to the severity of the accident, including the following.

- There are differing opinions between management and craft workers regarding boundaries defining skill of the craft work.
- Facility personnel failed to act in a timely manner on the recommendation to use ground fault protection.
- There was inadequate metal-to-metal contact between the circuit breaker bucket and the motor control center chassis.
- The electrical worker was not wearing natural-fiber, long-sleeved clothing or hand protection.

Managers and supervisors should ensure that job hazards are identified. DOE facility managers should ensure that personnel understand the basics of work control practices and must adequately communicate their expectations with respect to skill of the craft work. Personnel in charge of system changes should ensure that all hazards associated with making a change are identified during work planning and that facility documentation, including procedures and drawings, is updated and accurate.

- DOE O 5480.19, *Conduct of Operations Requirements for DOE Facilities*, chapter VIII, "Control of Equipment and System Status," states that DOE facilities are required to establish administrative control programs to handle configuration changes resulting from maintenance, modifications, and testing.

- DOE/ID-10600, *Electrical Safety Guidelines*, prescribes electrical safety standards for DOE field offices and facilities. Included in the guidelines is information on training and qualifications, work practices, protective equipment, insulated tools, and recognition of electrical hazards.

- DOE-HDBK-1092-98, *Electrical Safety*, contains explanatory material in support of OSHA regulations and nationally recognized electrical safety-related standards. This document addresses electrical safety for enclosed electrical and electronic equipment and discusses the latest editions of 29 CFR 1910 and 1926 and National Fire Protection Association Standard 70E, "National Electrical Code."

KEYWORDS: electrical hazard, work planning

FUNCTIONAL AREAS: Industrial Safety, Configuration Control

3. OPERATORS EXPOSED TO TRIMETHYLAMINE ABOVE SHORT-TERM EXPOSURE LIMIT

On June 30, 1998, at the Idaho National Engineering and Environmental Laboratory Advanced Test Reactor, three reactor auxiliary operators were exposed to trimethylamine above the short-term (15-minute) exposure limit while recharging anion exchange resin in a demineralizer tank. Investigators believe that the excessive off-gassing of trimethylamine resulted from the drums of resin being stored at a higher temperature than that recommended on the material safety data sheet. The operators were exposed for less than 30 seconds and did not exhibit any symptoms of respiratory problems. Exposure to hazardous chemicals in excess of recommended exposure limits may result in personnel injury or death. (ORPS Report ID--LITC-ATR-1998-0014)

Investigators determined that the operators were recharging the anion exchange resin in accordance with a procedure that was developed using information from the material safety data sheet provided by the resin manufacturer. They also discovered that operators have successfully performed this task several times a year for the past 30 years. The procedure required operators to empty nine barrels of resin into an open resin addition tank. Operators noticed an ammonia type of odor when they opened the drums, but they did not consider the odor to be any stronger than normal. When they dumped the first barrel into the tank, they noticed that the odor was much stronger than normal. As they dumped the second barrel into the tank, the operators decided that they could not continue because the odor was so strong. The operators stopped work and contacted a chemistry coordinator and an industrial hygienist for assistance.

The chemistry coordinator and the industrial hygienist generated a safe work permit that prescribed the use of full-face respirators with organic filter cartridges to complete the job. The industrial hygienist measured the concentration of trimethylamine in the workers breathing zone while the third barrel of resin was dumped into the tank. The industrial hygienist determined that airborne concentrations of trimethylamine were approximately 300 parts per million. The National Institute for Occupational Safety and Health specifies a short-term exposure limit of 15 parts per million averaged over a 15-minute period for trimethylamine. The facility manager shut down the resin recharging job to further evaluate worker safety controls.

The resin manufacturer stated that buildup of trimethylamine vapors is dependent on the age of the resin and the temperature at which the resin is stored. The material safety data sheet states that the resin should be stored in a "cool dry place." However, the resin had been stored for 2 weeks in the reactor primary coolant pump motor area. Temperatures in this area sometimes exceeded 114 degrees Fahrenheit during the 2-week storage period. The resin is usually staged in the pump motor area immediately before recharging the demineralizer. However, this time it was staged in the pump motor area earlier than usual because operators knew that temporary restrictions on truck door operations would preclude delivery of the resin on the date that recharging would occur. The facility manager is evaluating corrective actions that include minimizing storage time, minimizing exposure to elevated temperatures, and using respiratory protection during resin recharging.

This occurrence underscores the importance of thorough compliance with material safety data sheet information. If the resin had been stored in compliance with data sheet information, it is unlikely that operators would have been exposed to trimethylamine at greater than recommended safe levels. Managers of facilities where these resins are stored and used should review their material safety data sheets to ensure that storage requirements are being met. Facility managers responsible for determining how and where chemicals are stored should consult the DOE Chemical Safety Home Page. The URL for the Home Page is http://tis.eh.doe.gov:80/web/chem_safety/.

National Research Council Publication ISBN 0-309-05229-7, *Prudent Practices in the Laboratory: Handling and Disposal of Chemicals*, 1995, provides guidance and recommendations regarding the safe handling and storage of chemicals, primarily in laboratory settings. Information on how to order this book can be obtained from the National Academy Press, 2101 Constitution Avenue, N.W., Washington, D.C 20418. This book can also be ordered from most larger book stores.

KEYWORDS: hazardous material, industrial hygiene, inhalation, storage

FUNCTIONAL AREAS: Materials Handling/Storage

4. POOR EXCAVATION WORK PLANNING AT SAVANNAH RIVER SITE

On June 30, 1998, at the Savannah River Site H-Area, site utilities workers excavated soil to cut and cap a buried 3-inch domestic water line in close proximity to a radioactive waste transfer line without making required notifications or coordinating with appropriate facility operations personnel. Work planners knew there was a radioactive waste transfer line in the area, so they required hand-digging to avoid damaging the transfer line. H-Area personnel observed the excavation work in an area they knew contained buried radioactive waste transfer lines, questioned the workers regarding the work in progress, and determined that required notifications to the radiation control supervisor were not made. They also determined that work planners did not coordinate with H-Tank Farm and Defense Waste Processing Facility operations personnel,

so no precautions were taken to isolate the line or otherwise protect workers from potential radiation hazards. No radioactive waste was transferred through the line while workers were excavating. Failure to coordinate work between affected facilities and organizations created the potential for worker exposure to a radiation hazard. (ORPS Report SR--WSRC-HTANK-1998-0018)

Investigators determined that the site utilities organization issued a work permit but work planners failed to recognize the hazards associated with a Defense Waste Processing Facility recycle transfer line in close proximity to the domestic water line. When the radiation control supervisor notified the H-Tank Farm supervisor of the work in progress, the H-Tank Farm supervisor ordered all work to stop at the excavation. He contacted the Defense Waste Processing Facility to ensure that no transfers would come through the line and had workers install barricades and properly post the area.

NFS has reported on inadequate work planning in several Weekly Summaries. Following are some examples.

- Weekly Summary 98-01 reported that a construction subcontractor at the Los Alamos National Laboratory performed trenching operations using an excavation permit that was issued only for exploratory soil boring to help determine the exact location of buried utilities. Investigators determined that the Los Alamos National Laboratory project leader had not ensured development of the required security plan and did not coordinate with the ecology group before trenching operations began. They also discovered that the Los Alamos National Laboratory project leader gave permission for the subcontractor to proceed with trenching operations. (ORPS Report ALO-LA LANL-FIRNGHELAB-1997-0007)

- Weekly Summary 97-20 reported that subcontract construction workers at the Sandia National Laboratories excavated without following the required radiological work controls. The hazard assessment for the work required a radiological work permit for excavations deeper than 6 inches and required notification of Radiation Protection Operations personnel before starting. Investigators determined that elements of the hazard assessment that addressed the radiological hazards had not been implemented. (ORPS Report ALO-KO-SNL-NMFAC-1997-0005)

This event illustrates how the lack of thorough work planning and coordination could affect worker safety. The responsibility for ensuring adequate planning and control of work activities resides with line management. Management and integrating contractors need to closely supervise subcontractors that perform construction and maintenance work at DOE facilities. They should ensure that personnel understand all hazards associated with the job and workplace.

- DOE-STD-1050-93, *Guideline to Good Practices for Planning, Scheduling, and Coordination of Maintenance at DOE Nuclear Facilities*, provides information on work controls and work coordination.

- 29 CFR 1926, *Safety and Health Regulations for Construction,* paragraphs .651(b) and .416(a)(3), assign employers responsibility for identifying underground hazards near the work area.

KEYWORDS: construction, excavation, radiation protection, work planning

FUNCTIONAL AREAS: Construction, Industrial Safety, Hazards Analysis, Radiation Protection, Work Planning